Space Weather Technical Forecast

Issued on Monday, 02 September 2024 at 13:28 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flares expected, slight chance of X-flares. Chance of G1-G2 Geomagnetic storms days 2 and 3 (03 and 04 Sep). Chance of reaching S1/Solar radiation Storm levels on days 1 and 2 (02/03 Sep).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity has been Moderate with up to five M-flares in the past 24hrs, peaking with a long period M5.5 flare at 01/1322UTC from the southeastern limb. There are ten sunspot regions on the visible disc, three of which are of note. AR3807 in the southwest is the largest region, showing continued growth, with an increasingly complex intermediate section which has now formed a delta region. AR3806 in the southeast is showing minor proliferation of intermediate spots, and also retains it's small weak delta spot in the southern portion. Finally, the recently numbered AR3813 in the far southeast, appears to be a large and complex region with mature penumbra around leading, trailing and compact central regions. This spot may show some further complexity yet, though due to foreshortening it is hard to distinguish the magnetic configuration at present. All other regions are relatively simple and stable.

No Earth directed CMEs have been observed, though a large eruption off the southeastern limb during the UTC afternoon of 01 Sep may give slight peripheral impacts.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured by ACE at L1, have generally been at background conditions. Wind speeds have ranged from 380-470 km/s. Density has generally been around average. The Interplanetary Magnetic Field, Bt, was weak throughout, below 8 nT. The important north-south component, Bz, was similarly weak, fluctuating between -7/+5nT. Phi angle was almost entirely negative (towards the Sun). Geomagnetic activity was Quiet to Active (Kp 2-4).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 has continued to rise in response to the eruption and M5.5 flare mentioned above but remains below the S1/Proton Storm level. High energy electron flux (greater than 2MeV) observed at GOES16 was at background to moderate levels. The 24-hour fluence was below the Active threshold, with 4.61e6 integrated pfu observed at 02/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected with a slight chance of isolated X-flares. The main flare risk is currently from AR3806, AR3807 and AR3813.

Solar Wind /Geomagnetic Activity: There are no Earth-directed CMEs currently expected, though peripheral impacts from the subsequent CME from the M5.5 flare on 01 Sep may occur at Earth on days 2 or 3 (03/04 Sep). A possible enhancement may occur day 1 (02 Sep), from a narrow negative polarity equatorial coronal hole. Any significant enhancement is unlikely however, with solar winds remaining slow-ambient to slightly elevated.

On the whole, mainly Quiet to Unsettled (Kp 2-3) activity is expected. On days 2 and 3 (03/04 Sep) there is a chance of G1-G2/Minor-Moderate Storm intervals (Kp 5-6) should there be any peripheral impacts from the M5.5 Flare from 01 Sep.

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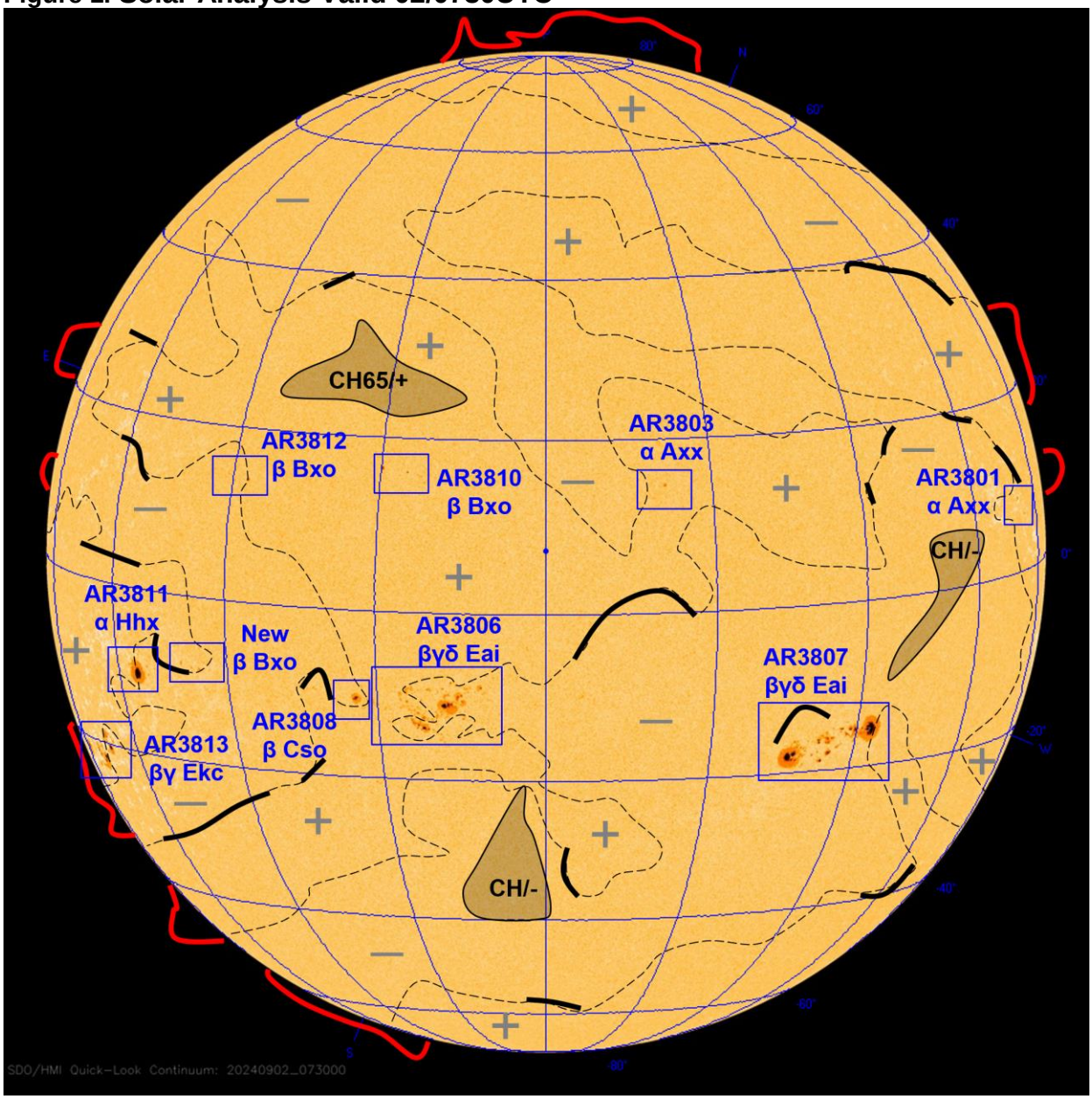
Energetic Particles / Solar Radiation: High energy proton flux is above background and on a rising trend in response from the M5.5 flare and CME at 01/1322UTC. There is a chance of reaching the S1/Minor Radiation Storm level on days 1 and 2 (02/03 Sep) from any further notable flares or as a gradual response from the aforementioned CME. High energy electron flux is expected to remain at background levels, perhaps reaching moderate at times during diurnal maximum. The associated 24-hour fluence is expected to persist below Active.

Figure 1. Solar Analysis Valid 02/0730UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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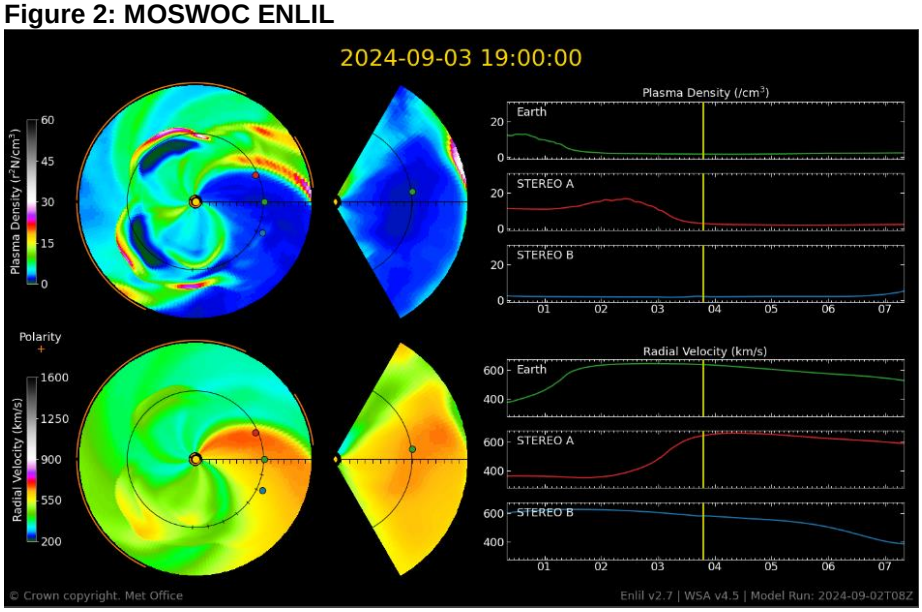
Geomagnetic Storms:

There are no Earth-directed CMEs in the forecast. A filament eruption from 30/2330UTC is expected to miss behind Earth's orbit, but the analysis is low confidence due to poor available imagery, and so a glancing blow cannot be ruled out, perhaps on Day 2 (03 Sep). A large eruption off the southeastern limb through the UTC afternoon of 01 Sep has been analysed, with no direct Earth-directed component expected, though LASCO C3 imagery does show a portion of ejecta on the opposite (northwest) side of the Sun, therefore shock or potential glancing impacts cannot be ruled out for this eruption. As such, a chance of G1-G2/Minor-Moderate Storms has been accounted for when most of the Ejecta reaches 1AU on day 2. The shock and/or any ejecta directed toward Earth may be slower, therefore the risk continues into day 3.
Solar winds are at slightly elevated levels, a narrow negative polarity coronal hole straddling the equator in the western hemisphere may connect to Earth on day 1 (02 Sep). Any notable fast wind from this region is low confidence however, due to its small size, lack of persistence and unfavoured polarity for the time of year. MOSWOC Enlil is thought to be overestimating the enhancement, suggesting a strong and broad coronal hole fast wind connection that is not expected.
On the whole, mainly Quiet to Unsettled (Kp 2-3) activity is expected. On days 2 and 3 (03/04 Sep) there is a chance of G1-G2/Minor-Moderate Storm intervals (Kp 5-6) should there be any peripheral impacts from the M5.5 Flare from 01 Sep.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	30	30	1
Strong	G3	No	1	5	5	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL



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Radio Blackouts - X-Ray Flares:

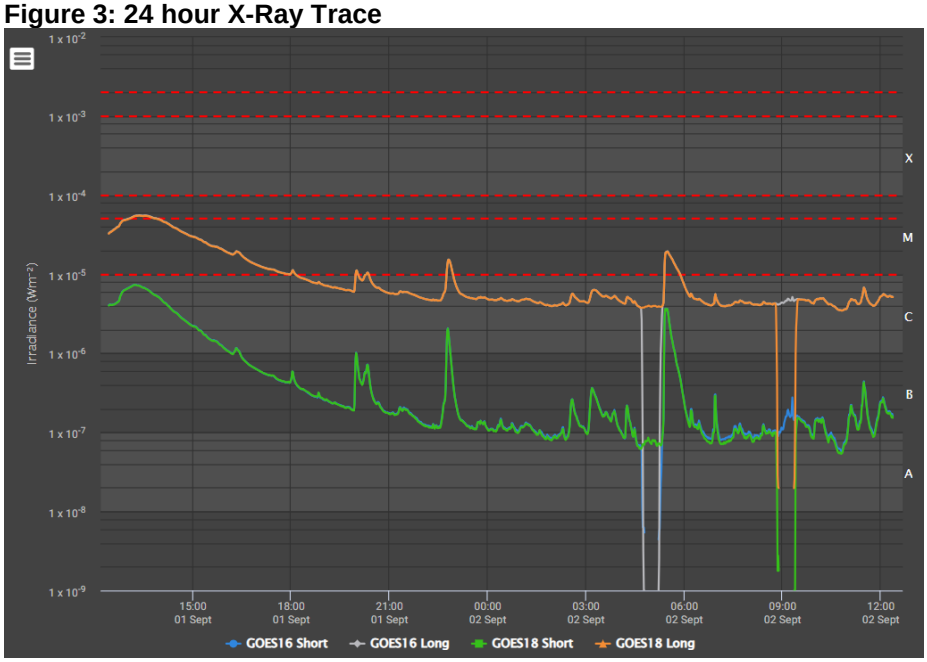
Activity is Moderate with up to five M-flares in the past 24hrs, the largest of which was a long duration M5.5 flare from a AR3813 when it resided on the southeast limb, peaking at 01/1322UTC.

There are ten sunspot regions on the visible disc, three of which are of note. AR3807 in the southwest is the largest region, showing continued growth, with an increasingly complex intermediate section which has now formed a delta region. AR3806 in the southeast is showing minor proliferation of intermediate spots, and also retains it's small weak delta spot in the southern portion, though this is becoming tenuous. Finally, the recently numbered AR3813 in the far southeast, appears to be a large and complex region with mature penumbra around leading, trailing and compact central regions. This spot may show some further complexity yet, though due to foreshortening it is hard to distinguish the magnetic configuration at present. All other regions are relatively simple and stable.

Further Moderate activity is expected, with a slight chance of rising to High. The emergence of new regions on the east limb will likely balance any losses with a flat trend maintained throughout.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	80	80	80	80
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 3: 24 hour X-Ray Trace



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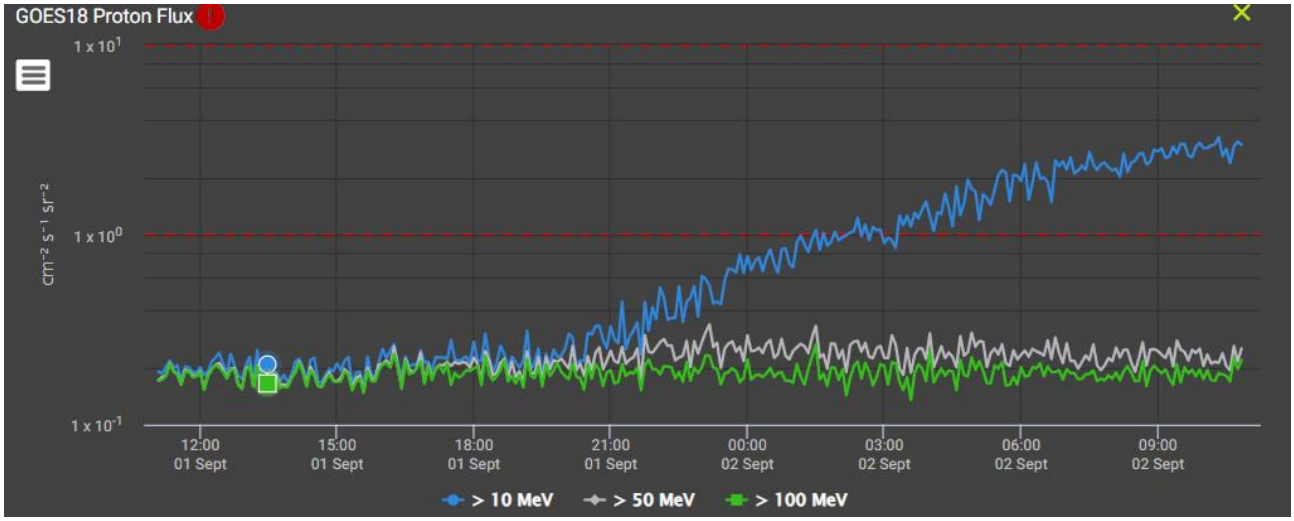
Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18, is on an continual upward trend in response to the large eruption and M5.5 flare off the southeastern limb during the UTC afternoon of 01 Sep, though it is expected to level off below the S1/Minor Radiation Storm level, though there remains a risk of further enhancements. Further notable flare bring the chance of breaching the S1/Minor Radiation Storm level should they occur within the next two days whilst proton levels are elevated.

From day 3 (04 Sep), proton flux is likely to fall back to background levels with a slight chance of rising in response to any notable flares, with AR3806, AR3607 and AR3813 being the most likely candidates for this.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	30	30	15	15
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: 24 hour proton trace



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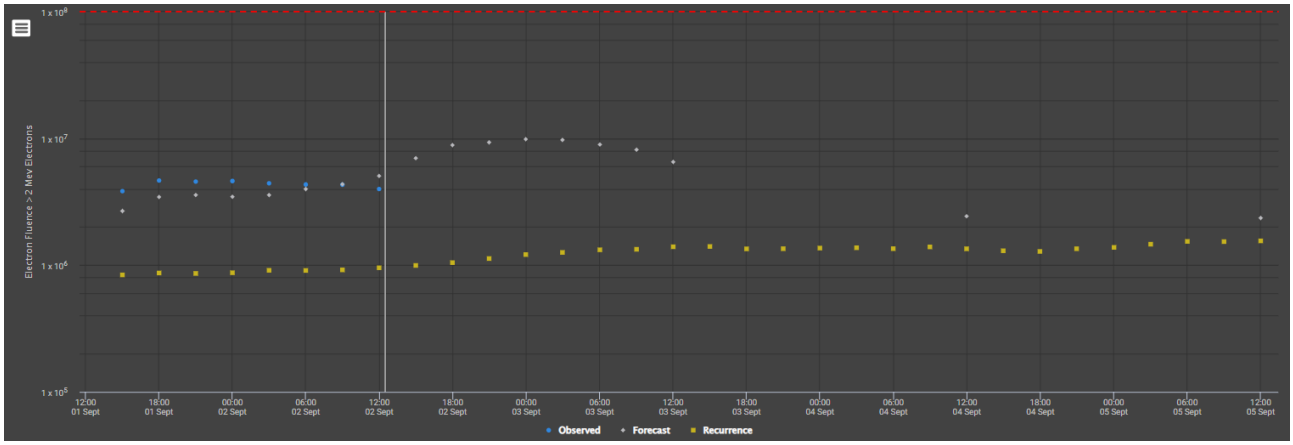
High Energy Electrons Event (≥ 2MeV):

High energy electron flux as observed by GOES-16 is mostly at background levels, with moderate diurnal rises. Whilst there is the potential for increased electron counts at lower orbits, this is considered unlikely to be significant. Periods of moderate flux may continue during diurnal maxima over the coming days.

Despite the potential for any increased flux, the associated 24 hour Fluence is expected to remain below the Active (1e8 integrated pfu) threshold throughout, although a slight rising trend is possible. MOSWOC REFM is providing good guidance for staying below this level.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM integrated flux/fluence forecast/observations/recurrence.



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